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DISPOSAL OF WASTE CRANK-CASE OILS

A report containing recommendations for controlling the disposal of waste automobile crank-case oils so as to avoid contamination of public sewers was issued under date of November 15, 1928, by J. B. Gordon, sanitary engineer of the District of Columbia.

This report contains excerpts from replies received to a questionnaire sent by Mr. Gordon to many cities in the United States and foreign countries. These replies show that a large percentage of municipalities recognize the danger involved in allowing great quantities of oil, often containing considerable amounts of gasoline, to enter the sewers. Many cities have adopted regulations covering the disposal of waste oils, but often such regulations are not successful in accomplishing the desired object, because, while the regulations prohibit the

dumping of oils into the sewers, no recommendation is made as to what is to be done with them.

The report gives briefly the results of an investigation conducted by the Bureau of Standards, in which it was shown that by the use of a special rerefining process oils suitable for use in automobile engines can be recovered from waste crank-case oil. A table gives the properties of the new, used, and re-refined oils, based on tests of samples obtained by the bureau from the Post Office Department and the Office of the Superintendent of Public Buildings and Parks. In a second table values are given for used and rerefined oils collected from a public filling station.

Mr. Gordon concludes his report as follows:

With all the information as cited herein at hand, including the reports from the United States Bureau of Standards showing the value of the product, the plumbing regu-

lations of the District of Columbia were recommended to be revised in this respect and amended to require the maintenance by garages, filling and service stations, automobile repair shops, etc., of approved containers or underground tanks, separate and apart from garage traps, for the retention of all waste crank-case oils, the contents of the same to be removed by the occupant or operator at regular intervals or upon notice from the District authorities. Regulations for the safe transportation of this commodity are also included in the proposed amendments.

The adoption of these regulations will necessarily require provision to be made for the safe and systematic disposition of the waste oil so retained. The dumping grounds in the District and vicinity have prohibited the receiving of such refuse (waste oils or contents of garage traps), and in order that the public may be fully protected in the matter of disposition of these accumulations of waste oil retained under such regulations, particularly as to the more or less isolated sections being properly provided with disposal service, a proposal is being submitted for approval whereby a contract may be made under competitive bidding for the collection, transportation, and disposition of such waste oil as may become available. Such services as may be contracted for will be guaranteed by proper bond, regulated by direct supervision of the District Government as to scope of service, maintenance of facilities for collection, transportation and disposition, and all other conditions which will make for a thorough and systematic service.

In view of the fact that the refined product has been determined usable and valuable, it is expected that this contract service will be without cost to either the District or the public, the contractor realizing his earnings from the ownership of the available oils so collected. No monopoly is to be granted the contractor, except that requests made by the public on the District for the removal of oil will become an order on the contractor for the rendering of this service. In this way the outlying sections of the District will be supplied with disposal service on a par with the more densely populated part of the city. The occupant or operator of any premises may dispose of the oil so retained in any manner he may choose, the only stipulation being that its disposition must be in accordance with the regulations.

Under these conditions it is estimated that more than 200,000 gallons of waste oil should be available for collection annually. It is believed that the public will be quick to realize the importance attaching to the exclusion of this waste from the public sewers as well as appreciate the advantage to be gained from its free and regular removal, especially the latter, as it costs the operator

some 2 to 3 cents per gallon to have it removed when deposited with silt in garage intercepting traps. A decided improvement of the condition of the interior of public sewers may confidently be expected to result from the adoption of these measures, the danger from fires and explosions in sewers minimized, thousands of gallons of oil which has heretofore been a source of danger and expense conserved for reuse, and a commercial enterprise of appreciable moment encouraged and developed.

THE CARBON ARC VERSUS SUNLIGHT

Letter Circular LC-225 of March 5, 1927, summarized "Some outstanding accomplishments of the Bureau of Standards in 1926," including a summary of a research on the radiation emitted by the carbon arc lamp, in which it is stated that, "of all the artificial illuminants tested, the carbon arc is the nearest approach to sunlight in spectral energy distribution." Unfortunately this whole caption is being used in the advertising literature with the inevitable result of an increased demand for this letter circular which is now out of print. It is therefore desirable to publish a further statement on this subject.

First of all, it is to be emphasized that no artificial source of radiation has yet been found which has a spectral energy distribution exactly like that of sunlight. Of all the sources examined the spectral energy of the carbon arc is the closest approach to sunlight; but even this is not an exact match of sunlight in spectral intensity. It contains ultra-violet radiation of very short wave lengths and infra-red radiation of long wave lengths, which are not found in sunlight. Moreover, it emits an intense violet radiation (the "cyanogen band") which is in excess of that observed in sunlight. By covering the carbon arc with a screen of special glass it is possible to shut out the ultra-violet rays of short wave lengths and the infra-red rays of long wave lengths, which are not present in sunlight; but the intense violet "cyanogen band" will remain until an amethyst-colored screen can be devised which will partly absorb this band.

Whether it is necessary to use artificial radiation having exactly the same spectral energy distribution as sunlight for therapeutic purposes remains to be determined, and is not a question for the bureau to decide. It is, however, relevant to add that the radiation emitted by the carbon arc depends upon the electric current and the kind of electrodes used (white flame, blue flame, yellow flame, red flame), and that it depends but little upon the kind of mounting of different manufacturers. Comparative data on the carbon and the mercury arc lamps (the former under different conditions of current, etc.) are given in Scientific Paper No. 539 obtainable only from the Superintendent of Documents, Government Printing Office, Washington, D. C. Price, 15 cents prepaid.

MELTING POINT OF NICKEL

The bureau has practically completed a determination of the melting point of nickel, based upon two samples prepared in its own laboratories. These samples, known as N19 and N23 were from different melts, and each was found to contain about 0.06 per cent of impurities, chiefly iron, cobalt, and copper. The main difference between the two samples lies in the fact that N19 contains these impurities in about equal parts, while N23 contains more iron and is nearly free of copper.

Nine freezes were observed on N19 by two observers. The average value obtained was $1,454.9^{\circ}\text{C.}$, the maximum deviation of any one freezing being 0.5°C. In addition, the readings of each observer, taken along, average $1,454^{\circ}\text{C.}$ The previous value which has been generally accepted as the best is $1,452^{\circ}\text{C.}$

Eight freezes have been taken on the second sample, N23, the average being likewise $1,454.9^{\circ}\text{C.}$, and the average of each observer's readings, taken alone, again being $1,454.9^{\circ}\text{C.}$, the maximum deviation of any reading of either observer being 0.4°C.

The bureau believes that enough work has been done to show conclusively that

the two samples of nickel are so nearly alike that all the observations on the 17 freezes may be treated as observations of the same sample. Considered from this point of view, 17 readings have been secured with a maximum deviation of 0.5°C. and a probable error of 0.05°C. It is believed that the result secured is not in error by more than 1°C. on the International Scale. This conclusion is based on the following estimates of the errors that may be present:

Source of error	Amount
Purity of nickel.....	-0.5
Transmission of sector.....	± 1
Effective wave length.....	± 5
Setting pyrometer.....	± 2
Maximum.....	1.3

THE PRODUCTION OF XYLOSE ON A SEMICOMMERCIAL SCALE

The Alabama Polytechnic Institute and the University of Alabama, cooperating through the Alabama Industrial Development Board, have arranged to work with the Bureau of Standards in the erection and operation of a small factory in which experiments can be made on the recovery of xylose from cottonseed bran and peanut shells on a semicommercial scale. The plant is now under construction by the Federal Phosphorus Co, at Anniston, Ala.

Xylose at present is a rare sugar, selling for about \$100 per pound, but possessing properties which ought to make it a desirable material for use in the food, textile, and leather industries. Its investigation is part of an extensive research program which the bureau is conducting with the object of discovering new uses for the waste products of agriculture. This work does not stop with the production of a marketable material in the laboratory but includes the discovery of profitable ways to dispose of this material. As a matter of fact, it is not so difficult to find how to make things from these waste products. The difficulty lies in finding how to make money out of them. The chief difficulties are economic rather than chemical.

Therefore, the bureau has found it necessary to build small factories in which the laboratory processes can be tried out on a production basis, thus making it possible to figure manufacturing costs with some degree of assurance. These small plants are useful in another way as well. They make possible the production of enough material to be actually used by likely consumers in their own plants, so that markets for the product may be explored. Thus, in the case of xylose, it seems probable that it will find a ready market in the industries mentioned, but there is no way to answer this question definitely while it is a laboratory curiosity. The erection of the plant at Anniston, with a capacity of 100 pounds of xylose per day with a manufacturing cost probably not exceeding 50 cents per pound, should soon give definite information on the subject.

USE OF ANTIOXIDANTS IN PRESERVING RUBBER

During the past two or three years several substances have been placed on the market which are designed to be incorporated in rubber compounds to prevent or at least retard deterioration through aging. These substances are designated by the general name of antioxidants. In the case of one or two of these, it has been claimed that it is beneficial to dip rubber articles already vulcanized into solutions of the antioxidants. In order to obtain data on the influence of this dipping process on the aging of rubber articles, tests have been made with five different antioxidants. Inasmuch as the penetration of antioxidants during the dipping process is probably not very great, the logical products on which to test the effect are thin rubber products, such as surgeons' gloves, rubber bandages, rubber bands, etc. Numerous samples of these articles were dipped in benzol-alcohol solutions of antioxidants for five minutes and then allowed to dry in the air. These were then exposed to aging under two conditions—first, indirect light, such as in an ordinary room; and, second, stored in the dark.

The results of tests of samples exposed to light show that in all cases the antioxidants have had a decided beneficial effect. Aging in storage is a much slower process than when rubber is exposed to light, and to date no difference is apparent between dipped and undipped articles.

PROTECTIVE COATINGS FOR PAPER CURRENCY

Through the use of paper having increased fiber strength, the proportion of the United States paper money that is redeemed because of its being broken or torn has been reduced until it is almost negligible. Most of the paper currency that is now withdrawn from circulation on account of being considered unserviceable is declared unfit because of oil or grease stains, dirt, creasing, and other evidences of surface wear. On account of this condition the cooperative investigation of the Bureau of Standards and the Bureau of Engraving and Printing has been extended to include a study of various materials for protecting the surfaces of the notes for the purpose of further prolonging the working life of paper currency.

At present sheets of notes are resized with animal glue, but the demands of large-scale production have prevented the employment of the low temperature drying methods that are essential for preserving in full the improvements contributed by the glue. The addition of tanning materials, such as formaldehyde, and of softening agents, such as glycerine, to the freshly sized paper has been studied, and the use of such reagents seems to offer considerable promise of improving the resistance of the resized notes to surface wear. The necessity of removing quickly the relative amount of water that is retained by papers resized with glue or other proteins, such as casein or albumen, has caused attention to be centered quite largely on the use of protective materials that may be applied with organic solvents. It is planned, however, to study the present resizing equipment in order to determine

if air-drying methods may be applied in order to enhance the effects of the glue sizing.

Various lacquers and varnishes have also been included in the investigation. Both cellulose nitrate and cellulose acetate lacquers have been tested. The work with varnishes has been limited in scope, but the materials used tended to make the paper surfaces somewhat sticky when warm and to increase the brittleness of the treated notes. Several nitrocellulose lacquers were tried, but these were generally considered to be impractical for large-scale application because of the strong and persistent odors of the solvents, which were of the type of amyl or butyl acetate, fusel oil, or similar materials. Objection was also raised to the excessively glossy surfaces imparted to the bills by the nitrocellulose lacquers used in the small-scale work.

With the cooperation of manufacturers of the material, the possibility of using cellulose acetate as the protective material has been studied quite extensively. Many combinations of different cellulose acetates, plasticizers, and solvents were tested until there was developed a solution capable of imparting to printed surfaces improved resistance to oil, water, and wet rubbing, without noticeably decreasing the high folding strength of the paper. The cellulose acetate forms a closely attached, invisible film that is free from gloss or stickiness and that does not bloom or discolor when dried at room temperature. Practical use of such a material would require special equipment for its application and for the removal of the organic solvents employed. In addition, as is the case with other surface protective agents, the question of the adherence of the overprinted sealing and numbering inks to such treated surfaces would require further careful study. These factors are now being considered.

Most of this work has been on a laboratory scale. It is now planned to undertake full-scale work with especial references to the drying of paper currency that has been resized with glue.

TESTS OF TERRA-COTTA FACED WALLS

The Bureau of Standards in cooperation with the National Terra Cotta Society has just completed a second series of tests on terra-cotta faced walls. The purpose of this work is to determine the best method of setting terra-cotta ashlar on buildings. Owing largely to lack of information on which to base requirements, most of the building codes do not give specific details covering this subject.

The test walls were $4\frac{1}{2}$ feet wide and $7\frac{1}{2}$ feet high and included the different types of construction now in vogue in different parts of the country. In some walls the terra-cotta voids were filled with brick and mortar, in others the voids were partially filled with concrete grout, and in still others the voids were left unfilled. The strengths of these walls were determined under different types of loading. On some walls the load was applied on the backing wall behind the terra cotta, on others it was applied on the terra-cotta facing only, and on still others it was applied uniformly over the terra-cotta facing and the backing wall. The vertical deformations of the terra-cotta facing and the backing walls were measured at different loads. The separation of the terra-cotta facing from the backing wall was also measured during loading.

It appears from the results that the filled terra cotta facing adds considerably to the strength of the walls. These would apparently justify reckoning filled terra cotta as a portion of the thickness of walls. Such a possibility has decided commercial advantages in that the structural framework would not have to carry so great a load and therefore could be constructed more economically. The adoption of thinner walls would also permit the use of a larger floor area for renting purposes.

It was also the purpose of this work to compare the strength of walls containing terra cotta ashlar with two vertical partitions and 6 cells, with those walls containing ashlar having three

vertical partitions and 8 cells. Although it is possible to build brick-filled walls with 6-cell ashlar, which are equally as strong as those with 8-cell ashlar, it was found that the concrete walls containing 8-cell ashlar were stronger than those containing 6-cell ashlar.

REACTION OF WATER ON THE CALCIUM ALUMINATES

An item on this subject was published in *Technical News Bulletin* No. 124 (August, 1927). A full report, giving in detail the results of this investigation, will appear in the December, 1928, issue of the *Bureau of Standards Journal of Research*, as Research Paper No. 34, under the title "Reactions of Water on the Calcium Aluminates."

In this investigation the four calcium aluminates ($\text{CaO} \cdot \text{Al}_2\text{O}_3$, $3 \text{ CaO} \cdot 5 \text{ Al}_2\text{O}_3$, $5 \text{ CaO} \cdot 3 \text{ Al}_2\text{O}_3$, $3 \text{ CaO} \cdot \text{Al}_2\text{O}_3$) were made, and the mechanism of their reaction with water was studied. Tricalcium aluminate, which appears to be the only aluminate present in Portland cement of normal composition and normal properties, reacts so rapidly with water that the changes in composition of resulting solutions could not be followed. The monocalcium aluminate and the 3:5 calcium aluminate occur in cements characterized by a high alumina content. These two aluminates, together with the 5:3 calcium aluminate and a high alumina cement, react with water to form metastable and supersaturated monocalcium aluminate solutions in the early periods. The metastable solutions decompose as the reaction proceeds with the precipitation of varying amounts of hydrated alumina and crystalline hydrated tricalcium aluminates with attendant increases in both the pH and molar ratio $\text{CaO}/\text{Al}_2\text{O}_3$ in the resultant solutions. If the metastable solutions are filtered from the reaction mixtures, they also decompose with the precipitation of the above phases. The resultant solutions, which are in equilibrium with these two phases, apparently attain the same composition as those left in contact with the calcium aluminates or high alumina cement for long periods.

A study of the subsequent changes in the aluminate solutions attended by increasing concentrations of calcium hydroxide, a product of the hydrolysis of the calcium silicates, shows that the alumina is almost completely precipitated from solution at a pH value of 12.0 or above.

The constitution of the aluminate solutions is discussed. Calculations based upon the electrometric measurements and chemical analyses indicate that the alumina in the aluminate solutions is in combination with lime as the calcium salt of monobasic aluminic acid.

Tricalcium silicate and beta dicalcium silicate appear to hydrolyze less in an aluminate solution than in water.

An electrometric titration study of aluminum chloride and calcium hydroxide is described. The conditions under which the aluminum precipitates as the hydroxide and as the calcium chloraluminate were studied. The formation of calcium chloraluminates from the reaction of calcium chloride with aluminate solutions is also described. The optical properties of the various hydration products are given.

TEST OF SLATER'S CEMENT

Frequent calls for tests on slater's cements have led to an improvised method for determining the adhesive and cohesive properties of such materials under conditions simulating those of service. The intended purpose of slater's cement is to produce and maintain a waterproof joint between slate shingles on the roof. The material is called upon to withstand rigorous weather conditions and remain sufficiently plastic to accommodate itself to structural movements.

Previous tests have been confined mainly to determining the effects of high and low temperatures on the physical state of the cement. The new test was designed to determine if structural movements of a given magnitude will break the joint and permit leakage.

The test is modeled on a procedure now in use for testing "elastic pointing materials." A joint is made of two

blocks of stone, one of which is fixed and the other so arranged that it can be moved toward or away from the fixed stone by means of a thread and nut. The movements can be accurately controlled and measured by a gauge between the two blocks. A cavity is made in the ends of the two blocks in such a way that it will hold water when the joint is sealed with the material to be tested. In testing a slater's cement, strips of slate shingles are sealed to the ends of the stone with sealing wax and then the joint is made between the slates with the cement in question. After the joint has set for one month the cavity is filled with water. If no leaks are noted the joint is stretched a small amount to simulate the effect of a structural movement.

Experiments so far completed indicate that a joint of slater's cement is usually capable of withstanding a movement of 0.01 inch at 70° F. after a drying period of one month, and some tests have indicated considerably higher values. This procedure seems to offer a satisfactory means of comparing different cements of this nature and to afford a basis for improvement of the product.

EFFECT OF WORKING GYPSUM MIXES AFTER STIFFENING

Calcined gypsum for certain purposes, such as for use in construction, must have a fairly quick set when mixed with water. However, sufficient time must be allowed to permit thorough mixing of the material and pouring into the forms before it starts to set. It has been generally accepted that the gypsum is useless if set has started before it is in place, inasmuch as little strength can be expected from the gypsum when worked through the set. Preceding the set a stiffening of the calcined gypsum putty occurs, and the question arose as to whether the material could be used after the stiffening of the putty had started. Some tests have been made to determine for what period the putty can

be worked without materially reducing the strength of the set gypsum.

A large batch of calcined gypsum was mixed with sufficient water to bring it to standard consistency, and three 3 by 6 inch cylinders were cast two minutes after mixing, and at one-minute intervals thereafter until the paste was too stiff to be forced into the mold, even by using considerable pressure. A typical set of results is given below.

Time after adding water	Compressive strength
	Lbs./in. ²
2 minutes.....	1,070
3 minutes.....	1,060
4 minutes.....	1,100
5 minutes.....	1,070
6 minutes.....	910
7 minutes.....	710

The material for the specimens at six and seven minutes had to be pressed into the mold. Similar results have been obtained using retarded mixes with longer time intervals between the casting of the specimens and using mixes containing various proportions of wood chips. It seems evident, therefore, that no weakening of the set gypsum occurs when the paste may be molded or formed without exerting undue pressure.

LIGHT COLORED GROUND COATS FOR SHEET IRON

A treatment of the metal used in this work has been described in Technical News Bulletin No. 133 (May, 1928). The metal is coated with a film of cobalt nitrate. This film decomposes at 300° C. (about 570° F.) and is thus rendered insoluble. The light colored enamel is then applied to the treated metal.

Sixty-three light colored ground coat enamels have been prepared and tested, the majority of them being clear glasses, although several of the frits¹ were very white and opaque. These were divided into four groups as follows:

¹A term used to denote the glass which forms the basis of a vitreous enamel

Ingredient	Group			
	G-2	G-3	G-4	G-5
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Feldspar.....				42
Silica.....	65	65	60	16.7
Boric acid.....	5-17	5	5	11.3
Sodium oxide.....	12-27	10-19	12-21	13.5
Lead oxide.....	0-18	6-15	6-18	
Fluorspar.....		0-9	5-17	1.5-11.5
Cryolite.....				0-10
Sodium antimonate.....				0-10

When applied to treated metal, the composition of the enamel does not seem to be the most important factor in its adherence. The strength of the test specimens and the type of fracture obtained depend more upon the thermal expansivity of the enamel and the firing temperature. It appears, therefore, that any ground-coat enamel now in use may be converted into a light colored one by simply eliminating the colored oxides and giving the metal a suitable treatment such as described above.

Of the four groups in the above table G-2 contained the best enamels, as these did not have as much tendency to crawl or blister and had a lighter color than any of the others.

If the Group G-2, containing 65 per cent silica, be plotted as the ternary diagram $PbO-Na_2O-B_2O_3$, the enamels just described will lie within a lozenge-shaped field bounded by the following limits: Boric oxide, 8 to 11 per cent; lead oxide, 0 to 6 per cent; and sodium oxide, 21 to 24 per cent. These enamels are fairly free from the ordinary enamel defects, as compared with the rest of the group or the other groups. They have good resistance to solution as tested with cold 20 per cent hydrochloric acid and fire down smoothly at 850° to 900° C. (about 1,560° to 1,650° F.). They are, however, rather difficult to melt and to grind.

SIMPLIFIED PRACTICE IN 1929

That simplified practice will be applied on an increasing scale by industry and business in 1929 is forecast by the increasing number of requests to the di-

vision of simplified practice for its co-operation; by the increasing number of inquiries reaching it regarding the application of simplified practice to wholesaling and retailing; and by the increased recognition and support accorded completed simplification.

Many of the inquiries reflect a good understanding of simplified practice, a familiarity with its adoption and use in manufacturing, and a desire to test its value in the solution of distributor's problems. There also appears to be a growing recognition among buyers in general, and purchasing agents in particular, that it pays to specify simplified lines when buying. Likewise, among jobbers and wholesalers, and to a lesser degree among retailers, there is trend not only toward stocking lines already simplified, but also toward individual simplification, wherein the distributor is analyzing his turnovers, line by line, and condensing his stocks to those items in most common demand.

Economies and benefits derived by those participating in the 100 simplifications effected with the aid of the division are becoming well known, and industries burdened with excessive variety, slow turnover, and increasing costs of stock maintenance are looking into simplification as a means of relief.

The high percentage of adherence to, or conformity with, the existing simplifications; and the fact that the division has 60 others under way, 20 of which came to it within the past few months, also indicate that simplification will be found among the better management plans of a good many firms in 1929.

TRANSPORTATION ECONOMIES THROUGH USE OF SKID PLATFORMS

The growth of the practice of shipping goods on skid platforms, thereby reducing the cost of handling, loading, and unloading, has been handicapped by lack of interchangeability in the necessary equipment. The American Society of Mechanical Engineers has estimated that \$3,500,000,000 a year represents the direct cost of material handling in this

country. Of this amount \$700,000,000 is estimated as the cost of handling, loading, and unloading goods which can be shipped on skids. Total possible savings from the general adoption of national standards of dimensions as defined June 28, 1928, by a general conference of representative manufacturers and users held under the auspices of the revision of simplified practice are estimated at from \$200,000,000 to \$500,000,000 per year. While the principal savings will accrue to shippers, railroads are expected to benefit through faster loading and unloading of cars and heavier car loadings in certain commodities, and manufacturing plants through easier maintenance of a steady flow of material. Mimeographed releases on this simplified practice recommendation may be secured upon request. It is interesting to note in connection with this simplification that six articles dealing with various phases of the skid handling of interplant shipment were presented at the annual meeting of the American Society of Mechanical Engineers held in New York City this month.

A COMMERCIAL STANDARD FOR CLINICAL THERMOMETERS

The printed pamphlet entitled "Clinical Thermometers, Commercial Standard CS1-28," was released for distribution on November 22. Copies of this pamphlet are available on request to those who may be interested. This illustrates how one industry is cooperating to safeguard the public by setting up rigid standards as a basis for daily trade and by certifying that each individual thermometer will meet all the requirements and tests of this commercial standard. The industry hopes by this means to set up a single rigid specification which can be accepted by all States and municipalities which now issue regulations regarding the sale of clinical thermometers, and, if possible, to remove the necessity for any further spread of State regulations designed to control the sale of this important instrument. It is also expected that the marketing of clinical

thermometers, accompanied by certificates guaranteeing conformity to the commercial standard, will enable the consumer to purchase with considerably greater confidence and assurance, and will remove the necessity for laboratory tests to check up on small deliveries.

DRYING BEHAVIOR OF SHALES AND CLAYS

One of the investigations being conducted at the Columbus branch of the bureau is concerned with the drying behavior of several shales and clays of the glacial and alluvial type. A humidity dryer of semicommercial size is used in this work. Water loss, shrinkage, and surface and center temperatures are determined on three green brick of commercial dimensions, the brick being made with a small combination pug mill and brick machine.

Although the data are as yet not sufficient to warrant drawing positive conclusions, a number of interesting facts have developed. It was found that a commercial sized brick made from the Rutland (Ohio) alluvial clay could be made to lose about 76 per cent of the added tempering water when dried at an average temperature of 26° C. and an average humidity of 94 per cent for 244 hours. At this point an equilibrium appeared to be established. At no time was the temperature above 27° C. or the humidity below 92 per cent. The brick lost weight steadily at a temperature of 25.6° C. and a humidity of 97 per cent, even after it had already lost about 33 per cent of the added tempering water.

The above is of interest in view of the fact that there is a rather prevalent opinion that clay will not dry out at such high humidities at this temperature range but on the contrary will absorb water.

Maintaining the same temperature, the humidity was lowered to 85 per cent, and the brick again lost weight. After it had lost about 1 ounce the humidity was raised to 94 per cent and the brick

gained 0.5 ounce in weight and expanded 0.003 inch in 10 hours. The brick were dried at 105° C. for 15 hours and again subjected to a humidity of 94 per cent at a temperature of 26.7° C. Under this treatment the brick absorbed water to the extent of 3 ounces (about 4 per cent of the dry weight) and expanded 0.011 inch in 69 hours. Thus, after about 75 per cent of the tempering water has been evolved, the clay can be made to gain or lose water at will by varying the humidity or temperature. However, the clay only regained about 50 per cent as much water at 94 per cent humidity after being dried at 105° C. as it held when equilibrium had been attained at this humidity after the drying process had been carried on for about 244 hours.

Two facts of importance are to be noted here—first, the reabsorption of water on proper change of condition and, secondly, the expansion which takes place coincidentally. It is entirely possible that considerable drier trouble might be traced to such change of conditions.

Shrinkage has practically ceased when about 75 per cent of the tempering water has been eliminated, this being the time that the equilibrium has been attained apparently at 94 per cent humidity; that is, this percentage possibly represents water present in a purely mechanical fashion. But, inasmuch as the remaining 25 per cent of water apparently exhibits equilibrium conditions at various humidities (temperature constant at about 26° C.), it is possible that this portion of the water is present in a definite absorbed or hydrate condition, each of the hydrates having its characteristic vapor pressure.

A further interesting fact is that the shrinkage varies with the length of time required to dry the brick to the end of the shrinkage period. In the table below it is to be noted that the shrinkage of the Rutland alluvial clay is in every case greater the greater the length of the drying time.

Drying time	Total shrinkage	Shrinkage
	<i>Inches</i>	<i>Per cent</i>
4 hours.....	0.435	5.15
6 hours.....	.456	5.42
8 hours.....	.458	5.44
10 hours.....	.469	5.56
12 hours.....	.485	5.75
220 hours.....	.522	5.23

From this it would appear that to state shrinkage correctly the conditions under which the drying takes place should also be stated.

NEW PUBLICATIONS

Additions to Supplementary List of Publications of the Bureau of Standards (beginning July 1, 1928)

Journal of Research¹

Bureau of Standards Journal of Research, Vol. 1, No. 5, November, 1928 (RP Nos. 24 to 31, inclusive).

Research Papers¹

RP24. Mutual inductance and torque between two concentric solenoids; Chester Snow. Price, 5 cents.

RP25. A study of the hydrogen-antimony-tin method for the determination of oxygen in cast irons; Bengt Kjerrman and Louis Jordan. Price, 5 cents.

RP26. Note on the effect of repeated stresses on the magnetic properties of steel; M. F. Fischer. Price, 5 cents.

RP27. Effect of twist on cotton yarns; A. A. Mercier and C. W. Schoffstall. Price, 5 cents.

RP28. Design of tuned reed course indicators for aircraft radiobeacon; F. W. Dunmore. Price, 5 cents.

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